

Appl. No. 10/627,165
Amdt. Dated July 13, 2006
Reply to Office Action of June 13, 2006

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REMARKS

This is a full and timely response to the non-final Office action mailed June 13, 2006. Reexamination and reconsideration in view of the following remarks is respectfully solicited. Claims 1-21 are pending in the application.

Claims Rejections – 35 USC § 102

Claims 1-3, 6-11, 13, 14, and 16-21 were rejected under 35 USC § 102(e) in view of Chen et al. (US Patent 6,811,680). This rejection is believed to be in error for at least the following reasons.

The pending claims include three independent claims. Independent claim 1 recites, in part, "electrodepositing a layer comprising copper having a substantially planar upper surface ... and polishing the layer comprising copper and the barrier layer on a single polishing pad to remove the layer comprising copper and the barrier layer...." In a similar manner independent claim 13 recites, in part, "electrochemical mechanical plating a layer comprising copper having a substantially planar upper surface ...; chemical mechanical polishing the layer comprising copper and the barrier layer on a single polishing platen to remove the layer comprising copper and the barrier layer...." And independent claim 17 recites, in part, "electrodepositing a metal layer ..., the metal layer having a substantially planar upper surface ...; polishing the metal layer and the barrier layer on a single polishing pad to remove the metal layer and the barrier layer...."

The foregoing underlined portions of independent claims 1, 13, and 17 are not found in the recited Chen et al. reference. Chen et al. does not disclose a method for depositing a layer comprising copper (claims 1 and 13) or a layer of metal (claim 17) having a planar upper surface. The cited portion of Chen et al., column 2, lines 12-16, is silent as to shape of the surface of the deposited layer. As seen most notably in Figs. 13A and 13B, the surface of deposited copper material 1250 is not planar as claimed in the present application, but rather has peaks 1230 and valleys 1240 (column 24, lines 52-61).

Further, Chen et al. does not disclose a method for removing the layer (either a layer

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comprising copper or a layer of metal) and a barrier layer by polishing on a single polishing pad or platen. Consider the disclosed method of Chen et al. beginning in column 25. "Referring to FIG. 13E, the polishing between the substrate and anodic dissolution by the applied bias is continued until the barrier layer 1215 is reached. ... The barrier layer may then be planarized by a barrier polishing process as shown in FIG. 13F." (lines 11-16) More specifically, the Chen et al. reference states "Following the depositing and planarizing process, the substrate may then be transferred to a polishing apparatus for further planarization of the substrate. In one aspect of the invention, a substrate that has been deposited and polished as described above is transferred to a first platen, and residual or remaining deposited material, such as copper, is removed from the substrate surface. Residual material is broadly defined as any bulk material remaining after one or more polishing process steps has been performed on the substrate. Residual material may include copper containing material, such as copper, copper alloys, and/or doped copper as well as copper polishing by-products, such as copper oxides, removed from the substrate surface. Residual may partially or completely cover the surface a substrate, for example, a portion of the underlying barrier layer may be exposed when residual material is retained after a polishing step, or alternatively, no barrier layer may be exposed after a polishing process has been performed." (lines 17-34) The Chen et al. method clearly does not remove the layer comprising copper or other metal and the barrier layer on a single pad/platen as claimed. "In one example, substrate is positioned on a first platen containing a fixed abrasive polishing pad, and typically includes positioning the substrate on the fixed abrasive polishing pad at polishing station (not shown). The polishing process may use an abrasive free or abrasive containing polishing composition on a conventional or fixed abrasive polishing pad described above. The substrate may then be positioned for barrier removal on a second platen containing a polishing pad, which typically includes positioning a substrate on abrasive-free polishing pad disposed on a platen in a polishing station." (lines 35-45, emphasis added)

Chen et al. fails to disclose at least two elements recited in each of the independent claims (claims 1, 13, and 17) of the present application. Accordingly, it is believed that those claims distinguish over the cited reference.

Claims 2, 3, 6-11, 14, 16, and 18-21 depend, either directly or indirectly from one of the

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independent claims and so distinguish over the cited Chen et al. reference for at least the same reasons as do the independent claims from which they depend.

In addition, claim 2 recites "... wherein the step of polishing comprises the step of chemical mechanical planarizing the layer comprising copper and the layer of barrier material on a single soft polishing pad." The cited reference to column 25, lines 55-60 does not disclose a method for polishing the layer comprising copper and the barrier layer on a single soft polishing pad, but instead refers to a buffing operation after the barrier layer has been removed on a second polishing platen.

Claim 3 depends from claim 2 and recites a hardness limit on the soft polishing pad. As explained in the immediately preceding paragraph, Chen et al. does not disclose a method for removing the copper layer and the barrier layer using a single soft polishing pad. In addition, the portion of Chen et al. that is cited (column 11, lines 13-18) does not relate to the method for removing the copper layer and the buffer layer, but instead relates to the process for depositing the copper layer.

Claim 6 depends from claim 2 and recites the additional steps of "cleaning and buffing the field region on the single platen following the step of polishing." As explained above, Chen et al. fails to disclose the steps of polishing the layer comprising copper and the barrier layer on a single soft polishing pad. The reference therefore cannot disclose additional steps carried out on that single pad. Indeed the recited passage (column 25, line 53 – column 26, line 12) begins by stating "The substrate may then be positioned on a third platen in a third polishing station for a buffing process...." Chen et al. clearly fails to disclose the steps of polishing the layer comprising copper and the barrier layer and buffing the field region on a single soft polishing pad.

Claim 8 depends indirectly from claim 1 and recites the additional step of "polishing the insulating layer on the single polishing pad to planarize the field region." The cited passage in Chen et al. (column 22, lines 4-7) does not disclose polishing the insulator layer and specifically does not disclose the use of a single polishing pad to polish the low k insulator. The cited reference merely discloses that a lesser pressure must be used when polishing the passivation layer and the copper containing layer when those layers are applied over a low k insulator.

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Claim 11 depends from claim 1 and includes the step of depositing a "layer comprising copper having a thickness less than about 300 nm as measured over the field region." Chen et al. does not disclose the deposition of a layer comprising copper having a thickness less than 300 nm over the field region. Chen et al. at column 23, lines 18-21 discloses only etching a layer having a thickness less than 500 nm.

The same remarks provided above with respect to the rejection of claim 2 also apply to the rejection of claim 16. The recited Chen et al. passage does not disclose the step of polishing the layer comprising copper and the barrier layer on a single soft polishing pad, but instead refers to a buffing operation after the barrier layer has been removed on a second polishing platen.

With respect to claims 19 and 20, the cited Chen et al. reference fails to disclose the step of polishing the metal layer and the barrier layer at the second platen as claimed. Chen et al. does not disclose polishing the metal layer and the barrier layer on a single platen. See, for example, column 25 beginning at line 11 and more specifically beginning at line 35.

The same remarks provided above with respect to the rejection of claim 3 also apply to the rejection of claim 16. Chen et al. does not disclose the step of removing the layer comprising copper and the barrier layer using a single soft polishing pad. The portion of Chen et al. that is cited (column 11, lines 13-18) does not relate to a method for removing the copper layer and the buffer layer, but instead relates to the process for depositing the copper layer. The other portion of Chen et al. that is cited (column 25, lines 55-60) also does not relate to a method for removing the layer comprising copper and the buffer layer, but instead relates to a buffing process to minimize surface defects.

Claims Rejections – 35 USC § 103

Claims 4 and 12 were rejected under 35 USC § 103(a) as unpatentable over Chen et al. in view of Sinha et al. (US Patent 6,551,935). This rejection is believed to be in error for at least the following reasons. As explained above, the Chen et al. reference fails to disclose or suggest the invention claimed in claims 2 and 1, the claims from which claims 4 and 12 depend. The Sinha et al. reference fails to disclose or suggest the "missing pieces" absent from the Chen et al.

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reference. Specifically, for example, the Sinha et al. reference fails to disclose or suggest the step of "electrodepositing a layer comprising copper having a substantially planar upper surface." Note, for example the upper surface of material layer 20 in FIG. 2 of Sinha et al. and the description at column 4, lines 35-38. Accordingly, the combination of references fails to disclose or suggest each element of claims 2 and 1 and hence also fails to disclose or suggest each element of claims 4 and 12.

Claims 5 and 15 were rejected under 35 USC §103(a) as unpatentable over Chen et al. in view of Sinha et al. and Lee et al. (US Patent 6,919,276). Claim 5 depends from claim 1 and claim 15 depends from claim 13. As explained above, Chen et al. fails to disclose or suggest all of the elements of claims 1 and 13 and Sinha et al. fails to disclose or suggest the elements missing from Chen et al. The Lee et al. reference is silent as to the shape of the surface of copper layer 18B and is silent as to the use of a single polishing pad/platen. The cited portion of Lee et al. specifically notes that in a typical multi-step CMP process a different polishing pad is used to remove the barrier layer. Accordingly, the three reference combination fails to disclose or suggest elements found in independent claims 1 and 13. In addition, Lee et al. fails to disclose or suggest the ratios claimed. In the process discussed in columns 5 and 6, four different slurries or slurry mixtures are disclosed. None of those slurries/slurry mixtures has a copper:barrier layer selectivity of substantially 1:1 as claimed. Accordingly, claims 5 and 15 are believed to distinguish over the cited three reference combination.

Art Cited But Not Applied

The art cited but not relied upon (Tsai et al.) has been carefully reviewed but is not considered relevant to the invention as presently claimed.

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Conclusion

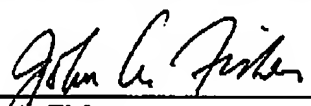
As discussed above, all of the pending claims are believed to distinguish over the cited references, taken alone or in combination. Accordingly, it is believed that the claims contain patentable subject matter and are in condition for allowance. Such allowance is earnestly requested.

If the Examiner has any comments or suggestions that could place this application in even better form, the Examiner is requested to telephone the undersigned attorney at the below-listed number

If for some reason Applicant has not paid a sufficient fee for this response, please consider this as authorization to charge Ingrassia, Fisher & Lorenz, Deposit Account No. 50-2091 for any fee which may be due.

INGRASSIA FISHER & LORENZ

Dated: 7/13/06

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